National Water-Quality Assessment Program

Water Quality in the Piedmont, Blue Ridge, and Valley and Ridge Aquifers

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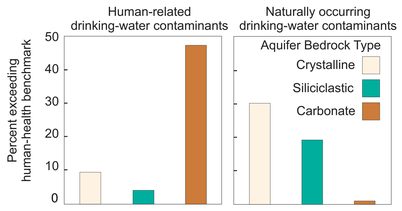
Bedrock type (crystalline-siliciclastic-carbonate) is a good indicator of whether concentrations in a sample will exceed a human-health benchmark[1]:
All systems are vulnerable. Water from wells in the carbonate-rock aquifers are much more likely to exceed a benchmark for a contaminant from human activity, and water from wells in crystalline- and siliciclastic-rock aquifers are much more likely to exceed a benchmark for a contaminant from natural mineral sources.

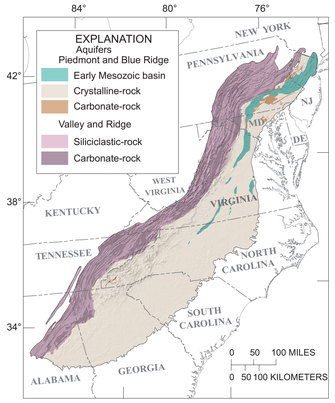
1 - Human health benchmarks include Maximum Contaminant Levels (MCLs) for regulated contaminants and Health Based Screening Levels (HBSLs) for unregulated contaminants.



The main naturally occurring drinking-water contaminants exceeding human-health benchmarks were radon, manganese, and arsenic. The main human-related drinking-water contaminants exceeding human-health benchmarks were nitrate and bacteria.

The Piedmont, Blue Ridge, and Valley and Ridge aquifers underlie an area with a population of more than 40 million people in 10 states. The suburban and rural population is large, growing rapidly, and increasingly dependent on groundwater as a source of supply. Domestic water-supply use from the five Principal Aquifers in the region is among the largest in the nation, with more than 550 million gallons per day withdrawn from these aquifers for household use. Current and potential future groundwater supplies include aquifers that frequently do not meet drinking-water standards for naturally occurring contaminants, and other aquifers that frequently do not meet drinking-water standards because of elevated concentrations of human-related contaminants. Understanding the natural and human factors affecting the quality of water provides a basis for effective management of these important water resources in the future.

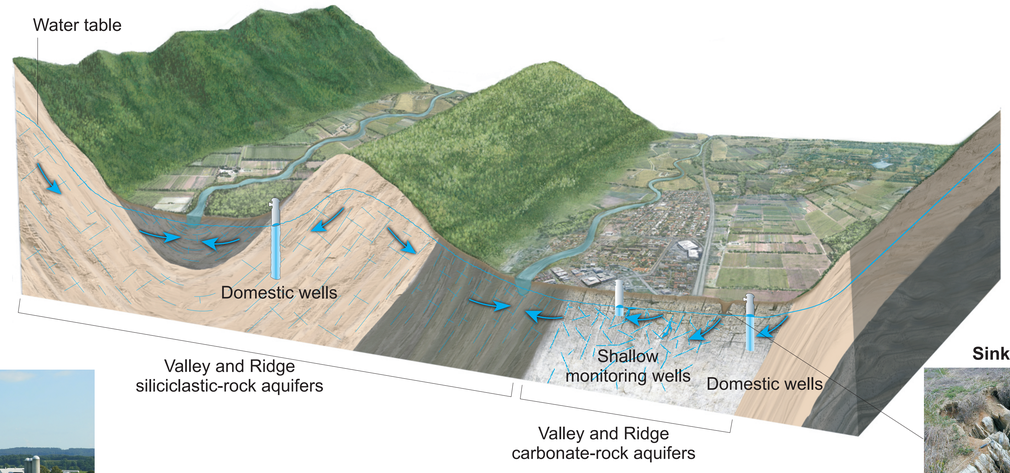
The five principal aquifers in the region:

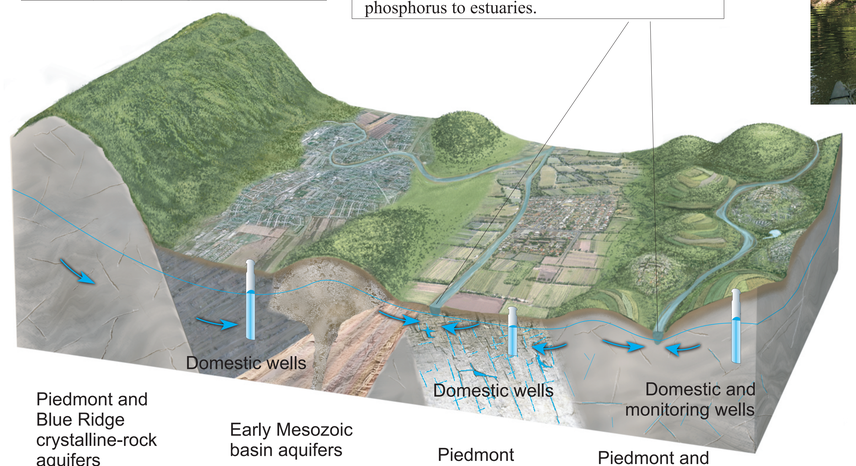


Groundwater is a source of nitrate and phosphorus to streams and coastal waters such as the Chesapeake Bay and Albemarle-Pamlico Sound

- About 50 percent of the nitrogen delivered by streams to the Chesapeake Bay originates from groundwater, with much of this coming from fertilizer and manure.
- Because groundwater moves slowly, it may take 10-20 years for changes in management practices at the land surface to be reflected in the concentrations of nitrate delivered to streams.
- In some areas, groundwater contains naturally occurring phosphorus from mineral sources at concentrations that already exceed in-stream criteria for phosphorus.

Understanding the role of groundwater as a natural source of phosphorus to streams could contribute to the ongoing development of nutrient management strategies to limit transport of phosphorus to estuaries.

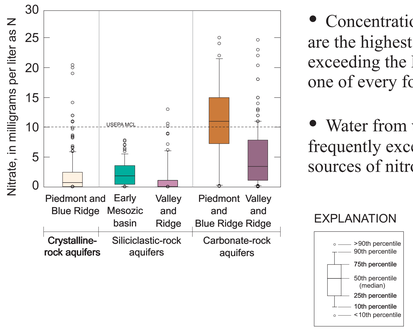




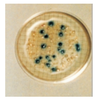
Sinkholes and other features of the carbonate-rock aquifers allow direct infiltration of contaminants.

A combination of bedrock geology and human activities on the land surface controls where concentrations of bacteria and nitrate in drinking water are potential human-health concerns

Carbonate-rock aquifers are highly susceptible to anthropogenic (human-associated) contamination because they have features such as sinkholes and conduits that allow contaminants to move rapidly from the land surface into the aquifer. The carbonate-rock aquifers are commonly overlain by large flat areas well suited for agricultural and urban development.



- Concentrations of nitrate in the carbonate-rock aquifers are the highest in the nation for domestic water supplies, exceeding the MCL of 10 milligrams per liter in water from one of every four wells or springs sampled.
- Water from wells in the crystalline-rock aquifers also frequently exceeded the nitrate MCL where sources of nitrogen were high in the area around the well.



- Fecal-indicator bacteria (*E. coli*) were detected in one-half of the drinking-water sources (wells and springs) sampled in the Piedmont and Blue Ridge and the Valley and Ridge carbonate-rock aquifers; however, bacterial contamination of well water occurred in all five aquifers.

Expansion of high intensity agricultural activities, such as confined animal feeding operations and increased acreage of corn for biofuels, in areas underlain by carbonate- or crystalline-rock aquifers is likely to increase concentrations of nitrate and bacteria in groundwater.

Radon, manganese, and arsenic in drinking water are potential human-health concerns; bedrock geology controls the locations where elevated concentrations of naturally occurring contaminants may be expected

- Naturally occurring contaminants are controlled by the source of the contaminant in the rock and geochemical conditions that allow the contaminant to be mobile. Radon, manganese, and arsenic exceed human-health benchmarks much more frequently in crystalline- and siliciclastic-rock aquifers than in carbonate-rock aquifers.
- Water from one out of 4 drinking-water wells in the Piedmont and Blue Ridge crystalline-rock aquifers exceeded the limit of 4,000 pCi/L picocuries proposed by USEPA as an Alternate MCL, one of the highest rates of exceedance in the Nation.
- 15 percent of samples in the Valley and Ridge siliciclastic-rock aquifers exceeded the HBSL of 300 µg/L for manganese.
- 9 percent of samples exceeded the MCL of 10 µg/L for arsenic in selected lithologic units in the Piedmont and Blue Ridge crystalline-rock and Early Mesozoic basin aquifers.

Groundwaters with radon, manganese and arsenic concentrations that exceed MCLs or HBSLs are focused in areas of Piedmont and Blue Ridge crystalline-rock and Early Mesozoic basin aquifers where specific lithologic units are present, allowing focused sampling and further analysis.